

4.0 ENVIRONMENTAL PROGRAM INFORMATION

4.1 Environmental Monitoring

NREL is not required to perform any environmental monitoring of its effluents or emissions by EPA or CDPHE regulations. This is because NREL's research activities, unlike typical manufacturing operations, do not generate large quantities of routine effluents or emissions that could cause measurable environmental pollution. Historically, NREL has conducted some limited environmental monitoring, primarily for the purpose of demonstrating the lack of environmental impact from its operations. Groundwater monitoring was initiated in 1990. Monitoring of wastewater effluent, ambient air particulates, and stormwater runoff were initiated in 1992 as a result of a DOE recommendation. The air and stormwater monitoring studies were completed in 1993, and wastewater and groundwater monitoring were completed in 1994.

The State of Colorado does not issue permits for NREL's research-related air emissions because of their small size and random nature of release (Colorado Air Regulation No. 3, II.C, Air Emission Notice Requirements, Exemption). NREL has compiled an air emission inventory that lists potential sources and quantities of air emissions for various air contaminants at NREL. According to NREL estimates, the total quantity of organic chemicals emitted from NREL's research activities is approximately 37 lb/yr (16.8 kg/yr), or 0.0185 tons. This estimate was made assuming that the entire volume of all stockroom chemicals used in one year was volatilized and exhausted to the environment. This is a conservative overestimate as large portions of the chemicals used in research experiments are ultimately found in liquid and solid products of the experiments. For comparison, dry cleaners emit an average of 5-10 tons of organics per year, and a typical laboratory or research institution emits between a few hundred pounds and 1 ton of organic materials per year. By comparison, NREL's emissions are negligible.

Because NREL has no industrial wastewater discharges to the environment, the laboratory is not required to have an NPDES permit or conduct any monitoring of specified pollutant parameters in its wastewaters. Random grab sampling and analyses of NREL wastewater have been performed in the past, but only minor concentrations of pollutants were detected. Routine wastewater monitoring at the DWOP leased facilities and at the STM site was initiated in mid-1992 and continued throughout 1994 (Applied Environmental Consulting, Inc., 1992c).

Composite wastewater monitors were used at the FTLB and Building 16 to sample laboratory wastewater. Both 24-hour composite and grab samples were taken at each location on a quarterly basis. Manual grab sampling was also performed at the Building 15 photography laboratory wastewater sump with the same frequency as the other sampling during 1992 and 1993. The sump was decommissioned in 1994, and direct sampling of photo lab wastewater streams was conducted throughout 1994 to verify compliance.

No radioactive air emission monitoring is conducted because of the extremely low usage of radioactive material at NREL. The Laboratory's radioactive as of March 1995 was less than 8.5 mCi, far less than most university or hospital radiochemistry laboratories.

Personal monitoring by way of thermoluminescence dosimeters (TLDs) is performed on NREL personnel who are working with any of the x-ray machines or in the labs where radioisotopes are handled or stored. Each worker wears a TLD that is sent to a laboratory for analysis at least once every quarter. TLDs would be sent for analysis immediately if an exposure problem were suspected. Additional information on this topic is provided in Section 5.

Annual sampling continued in 1994 for the groundwater monitoring program that was initiated in 1990 at the STM site. Samples from each well were analyzed for benzene, toluene, ethylbenzene, xylenes, total organic halogens (TOX), total organic carbon (TOC), pesticides, herbicides, phenols, arsenic, cadmium, mercury, selenium, barium, chromium, silver, manganese, sodium, iron, lead, nitrate, fluoride, chloride, sulfate, potassium, carbonate, silica, and calcium. Expanded organics sampling was conducted for 147 compounds. These data were reported to DOE-GO upon receipt of the annual report from the subcontractor performing the sampling.

Because characterization monitoring is complete and no significant environmental problems have been identified, routine monitoring for groundwater and wastewater will not be done in 1995. Additional monitoring will be done as needed if there is any activity that NREL and DOE feel poses a risk to environmental quality.

4.2 Environmental Permits

NREL holds air emissions permits for two of its seven gas-burning boilers on the STM site. NREL holds final permits on the two FTLB boilers. Further information is provided in Section 3.5.

NREL's air emissions permits are described in detail in Sections 3.5 and 3.17. Permitting and inspection of the boilers at the leased site are handled by the DWOP management. Fuel burning equipment supplying building heat at the JSF is below permitting thresholds, and the boiler at the NWTC is electric, so no permit is required.

A drinking water permit is in place at the NWTC, in the form of a public water supply identification number, issued July 6, 1994. Domestic water for the site is hauled from the City of Boulder water supply and stored in an underground tank until it is delivered at the tap. Supplemental disinfection and testing is performed according to state requirements.

Two permits are held by NREL with the U.S. Bureau of Alcohol, Tobacco, and Firearms. One is an Alcohol Fuel Producer permit issued June 30, 1994, for NREL's biomass to ethanol unit (PDU). The second is an Industrial Alcohol User Permit for the Withdrawal and use of Alcohol at NREL free of tax. The user permit was issued on June 4, 1985, and was revised in December 1994.

Two permits associated with SERF construction activity were necessary. A fugitive dust air emissions permit was issued by CDPHE on March 18, 1992. SERF construction began in April 1992 and was completed in 1993. The permit expired on January 1, 1994. An NPDES permit for stormwater discharge was also required. NREL filed a Notice of Intent with the EPA for coverage under the general permit for stormwater discharge associated with construction activity for the SERF construction site. A Stormwater Pollution Prevention Plan (SPPP) was prepared that outlined spill-control measures, erosion controls, inspection procedures, and recordkeeping requirements. The general contractor for construction, G.E. Johnson, installed the prescribed erosion controls and followed the spill-control plan that was a part of the SPPP to safeguard stormwater quality. NREL and G.E. Johnson performed the required inspections and ensured that any repairs or new conditions requiring controls are addressed in order to protect stormwater quality.

In 1995, NREL will apply for sitewide coverage under EPA's general permit for stormwater discharge associated with construction activity for the STM site. Sitewide coverage under the general permit became effective at the NWTC on November 30, 1994, for stormwater discharge associated with construction activities.

Table 4.1 summarizes NREL's permits.

4.3 National Environmental Policy Act (NEPA)

NEPA compliance activities at NREL during 1994 are described in the Compliance Summary in Section 3.4.

4.4 Waste Minimization Program/Pollution Prevention Awareness

Because NREL is a research and development laboratory and does not engage in any production activities, waste generation rates are predominantly controlled by the amount of research activity underway. Normally, NREL is a "small quantity generator" of hazardous waste, generating less than 1,000 kg (2,205 lb) of waste per month.

NREL's waste profile consists of hazardous laboratory chemicals that would be typical of any college, small university, or hospital operation. Chemicals in solid or liquid form are collected in each laboratory or at each experimental site. These wastes are periodically picked up from the laboratories and prepared for off-site disposal by the NREL Environmental Engineering Section.

NREL also generates a very small amount of radioactive waste. The average amount of radioactive waste generated is less than 1 cubic meter per year, including packing material. This waste normally consists of personal protective equipment, such as gloves, and water based liquids. Radioactive waste is shipped for disposal on an as-needed basis.

NREL's pollution prevention awareness program has been incorporated in the waste minimization program, and is called the Waste Minimization and Pollution Prevention Plan. The purpose of the

Table 4.1 -- Summary of NREL Permits

plan is to reduce resource usage, reduce hazardous constituents in waste streams, improve product yields, reduce health and accident risk, and reduce waste management and compliance costs. This will have the added benefit of reducing chemical inventories and the potential for releases reportable under the Emergency Planning and Community Right-to-Know Act, as well as reducing the potential for liability under environmental laws.

The current pollution prevention awareness program includes training on waste handling, waste minimization, and methods to eliminate releases to air, soil, or wastewater. In addition, the SSO integrates pollution prevention awareness into NREL activities by evaluating all proposed chemical purchases and communicating pollution prevention concepts to the requester (e.g., substitution of less hazardous chemicals or ordering smaller quantities); reviewing all SOPs and including pollution prevention recommendations; and communicating pollution prevention methods in internal NREL publications such as the NREL newsletter.

Although the Laboratory is somewhat vulnerable to circumstances beyond its control that may impair its ability to reduce waste generation rates, particularly fluctuations in its research activity level, NREL has instituted measures to minimize its waste volumes. Employees in the research organizations who generate hazardous waste are given pollution prevention and waste minimization training. This training emphasizes preplanning experiments to look for non-hazardous chemical substitutes and minimize over-purchasing. It also presents a brief synopsis of the different types of wastes generated by NREL's activities and the environmental laws that regulate these wastes, and discusses waste handling practices and recordkeeping procedures. This waste management/waste minimization training is mandatory for all waste generators and is ongoing, with classes held every week.

For those employees who do not generate hazardous wastes, training is comprised of an environment, safety, and health orientation video that is required viewing for all new permanent and temporary NREL employees and some contractor personnel as well. This video briefly discusses the waste management program at NREL and emphasizes that it is every employee's responsibility to be alert for any NREL activities that could have adverse environmental impacts.

NREL has established a chemical redistribution program to make chemicals in original containers available for reissue to research personnel at no cost. In addition to chemical redistribution, waste oil that has been verified to contain no hazardous contaminants is sent to a Colorado oil recycling firm. Other items that are currently recycled or reused by NREL include used lead-acid batteries; used oil; styrofoam popcorn and other packing materials; boxes; freon from refrigeration units; cleaning solvents; and scrap metal. NREL also sends used laser printer cartridges to a reclaimer who refills and redistributes them. NREL offers non-hazardous waste recycling opportunities to all employees, including programs for aluminum cans, newspaper, bond and photocopier paper, and magazines.

During 1994, NREL completed the waste minimization certifications required on all waste manifests for all waste shipments made. NREL recently received an exemption from DOE for its annual report on waste minimization activities at the facility for the 1994 calendar year.

4.5 Self-Assessments

No separate self-assessments were performed in 1994 above and beyond the semi-annual performance appraisals conducted for the Department of Energy.

4.6 Environmental Training

Two types of ongoing environmental training classes are conducted on site for NREL employees. As described in Section 4.4, waste management and minimization training is required of all waste generators, both laboratory staff and those involved in facility operation and maintenance. The course is taught by SSO-ES staff members whose specialty is the management and minimization of all types of waste materials. This training is provided as part of orientation for all new employees.

NEPA implementation training is also provided to NREL staff members who are responsible for planning and performing activities that could have potential environmental impacts. In this course, NREL's policies and procedures for NEPA implementation are presented, and a systematic method for evaluating various types of activities for environmental impacts is provided.

In addition to the laboratory-wide training described above, training is also provided to individual branches or other groups upon request in the areas of waste management and minimization, NEPA, environmental compliance, and chemical inventory system (CIS) implementation.

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

5.1.1 *Radioactive Effluent Data*

There are no nuclear operations at NREL and only minor use of radiation sources, all on the STM site. These include two x-ray diffraction machines at the SERF, two sealed gamma ray level sensors at the AFUF, and a sealed cesium source in storage at the FTLB. In addition, a few laboratories at the FTLB use small quantities of radioisotopes for biological labeling. The 1994 inventory of radioisotopes included carbon-14, tritium, sulfur-35, and phosphorus-32. NREL's total inventory of radioactive isotopes as of the first quarter of 1995 was as follows:

<u>Isotope</u>	<u>Activity</u>
C-14	7.661 mCi (2.8 x 10 ⁸ Bq)
S-35	0.250 mCi (9.3 x 10 ⁶ Bq)
H-3	0.500 mCi (1.9 x 10 ⁷ Bq)
P-32	<u>0.050 mCi (1.9 x 10⁶ Bq)</u>
Total	8.461 mCi (3.1 x 10 ⁸ Bq)

5.1.2 *Sampling for Radioactivity*

Monitoring is performed in the laboratories where radioactive isotopes are used. At present, personnel are monitored for direct radiation using TLDs, and equipment and facilities are monitored for removable contamination. Both types of monitoring aim to ensure that the work environment in laboratories using radioisotopes is maintained in accordance with prudent health and safety practices and DOE standards. NREL radiation SOPs prescribe proper storage, handling, contamination control, and disposal procedures for radioactive materials.

NREL personnel are monitored as described in Section 4.1. In 1994, the sum of effective dose equivalents for *all 25 personnel* monitored was 130 mrem, with a range of 0-50 mrem. This is a very low dose compared to the DOE yearly allowable dose for a *single individual* of 5,000 mrem. The results of all past analyses on dosimeters worn by NREL personnel are similar to the 1994 results.

Surveys are also done on removable contamination. These surveys are conducted by the researchers working with the isotopes after they conclude their experiments. Wipe tests are performed on any laboratory surfaces that could have become contaminated by the radioisotope work. These wipes are analyzed using a scintillation counter.

The two x-ray machines are registered with the State of Colorado and are inspected every 2 years by a state-licensed surveyor, in accordance with CDPHE radiation safety procedures. The surveyor inspects the x-ray machines and audits NREL's program for radiation safety in connection with operating the machines. X-ray diffraction machine inspections were performed in 1995, and the equipment was recertified for another 2 years.

5.1.3 Reporting Potential Dose to the Public

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," established radiation air emission limits for DOE facilities. Such emissions are also regulated by Section 112 of the Clean Air Act as implemented by 40 CFR 61, Subpart H, established by the EPA. According to 40 CFR 61, Subpart H, all DOE facilities must annually demonstrate compliance with the radionuclide emission limit which states that emissions to the ambient air may not exceed an amount that would result in any member of the public receiving an effective dose of 10 mrem/yr (40 CFR 61.92).

As a DOE facility, NREL must either use air emissions monitoring data or a computer model to demonstrate this compliance. Private and non-DOE federal facilities are determined to be in compliance if the quantities of radioactive material in their possession during the year are below EPA prescribed "annual possession quantities" (40 CFR 61, App. E). NREL would automatically be found in compliance if it were a private facility. EPA annual possession quantities for isotopes used by NREL are as follows:

<u>Isotope</u>	<u>EPA Annual Possession Quantity</u>	<u>NREL Inventory</u>
C-14290	Ci/yr(290,000 mCi/yr)	7.661mCi
S-3575	Ci/yr(75,000 mCi/yr)	0.250 mCi
H-315,000	Ci/yr(15,000,000 mCi/yr)	0.500 mCi
P-3217	Ci/yr(17,000 mCi/yr)	0.050 mCi

NREL's total inventory of all isotopes is less than 8.5 mCi (9.6×10^7 Bq). This is at least 2000 times less than the annual possession quantity of a single isotope that private facilities are permitted to store and still be automatically declared in compliance. Because NREL is a DOE facility and conducts no radiological air emissions monitoring, it must demonstrate compliance with the NESHAP standards in 40 CFR 61.

Given the extremely small quantities of radioactive materials used at NREL, no stack sampling or perimeter radionuclide monitoring is performed at any of NREL's four sites. Therefore, NREL demonstrated compliance with 40 CFR 61, Subpart H, by using the COMPLY computer model (40 CFR 61.93(a)) to calculate radionuclide emissions and public dose. The COMPLY dosimetry model and its resulting evaluation are selected to be very conservative and simplistic, and are intended for

use when sources are extremely small, as at NREL. According to the computer model, the potential dose to the public is 0.0017 mrem/yr, well below the standard of 10 mrem/yr; therefore, NREL is in compliance with the NESHAP for radionuclides. Because this dose is calculated rather than measured, it represents a potential or estimated dose rather than an actual dose.

As minuscule as the calculated radionuclide emissions are, they are extremely conservative overestimates of exposure because the formula for the calculation assumes that the entire quantity of the open containers of radionuclides used in 1994 was released, that the wind was blowing each radionuclide in the direction of the nearest receptor 25% of the time, and that the receptor at NREL's fence line raised and consumed all his own milk, meat, and vegetables at home. In addition, in performing the calculation, NREL assumed that each open container of radioisotopes was used at one time. In fact, because the amounts used in any one experiment are so small, the laboratory's inventory of radioactive materials is normally used over a number of months or years. Table 5.1 outlines the calculated maximum individual dose to the closest member of the public in comparison with DOE and EPA standards. Table 5.2 presents the maximum potential quantities of radionuclides released to the environment. These are the conservative values used in the COMPLY model. It should be noted that these values represent quantities of all open containers from which radioisotopes were used during 1994; it does not include radioisotopes that are in inventory in unopened containers.

Also in 1994, NREL evaluated its potential collective dose to the public within 80 km of the Laboratory. Collective dose provides an indication of the radiation hazard posed by NREL operations to the general population in the vicinity of the site. NREL has no radioactive liquid effluents; therefore, the potential for exposure is limited to the airborne pathway only. As stated above, the potential maximum whole-body effective dose equivalent to the nearest resident at NREL's fence line is 0.0015 mrem/yr (airborne emissions), as calculated by the EPA-approved COMPLY computer model. This value is extraordinarily low compared with the regulatory standards listed in Table 5.1. Because of the potential exposure levels involved, an assessment of the degree of hazard associated with NREL operations was performed by calculating a maximum potential individual dose at 80 km using the conservative COMPLY model, rather than modeling collective dose. According to COMPLY, an individual at 80 km from NREL, subject to the assumptions described above, and using the 1994 inventory and usage data, would have the potential to receive a maximum whole-body effective dose equivalent of 5.4×10^{-7} mrem/yr due to NREL operations. The regulatory limit for public dose is 10 mrem/yr.

5.2 Unplanned Radionuclide Releases

There were no unplanned releases of radioactive substances at NREL during 1994.

5.3 Radiological Environmental Monitoring

No radiological environmental monitoring was performed at NREL during 1994 due to the extremely small quantities of radioisotopes used at the Laboratory. Such monitoring is not required of NREL by federal, state, or local regulatory agencies, or by DOE.

Table 5.1
Calculated Maximum Individual Radiation Dose from NREL Facilities
(mrem/yr)

<u>Maximum Individual Dose**</u>	<u>EPA Allowable Dose Limit</u> (via ambient air)	<u>DOE Allowable Dose Limit*</u> (via all exposure modes)
<i>at NREL fence line:</i>		
1.5 x 10 ⁻³	10	100
<i>at 80 km from NREL:</i>		
5.4 x 10 ⁻⁷	10	100

* DOE 5400.5

** Natural background radiation level on the STM site, as measured by an informal beta-gamma survey, is approximately 0.02-0.05 mrem/hr (approximately 175-438 mrem/yr).

Table 5.2
Maximum Potential Levels of Radionuclides Released to the Environment
from NREL Facilities

Air Releases:

<u>Isotope</u>	<u>Half-life</u>	<u>Maximum Potential Release*</u>
C-14	5730 years	0.76 mCi
S-35	88 days	0.75 mCi

Water Releases:

None

* Activity of all open containers of each radioisotope was used to represent the maximum potential release.

6.0 ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

6.1 National Pollutant Discharge Elimination System Program (NPDES)

As discussed in Sections 3.6 and 3.7, NREL has no direct wastewater discharges to surface waters (or groundwater), and therefore does not require NPDES permits for wastewater. All NREL wastewater is discharged to the local POTW through the sanitary sewer system. It is NREL policy that no hazardous chemicals are to be discharged to the sewer system, and NREL staff is trained in this policy.

NREL is not required to obtain a permit from the local wastewater district for its wastewater effluent, nor is it required by the EPA, the State of Colorado, or the local sewer district to monitor its effluent at this time.

In response to a DOE recommendation, NREL began a routine wastewater monitoring program in July 1992 both on the STM site and at the leased facilities located at DWOP. The scope of the program is described in Section 4.1. The analytical results of this monitoring for 1994 can be found in Rust, 1994c-e and 1995a (see Reference List).

Limited stormwater monitoring was conducted during the summers of 1992 and 1993 to establish a baseline for surface water quality at NREL's current level of activity and to confirm that NREL's activities were not adversely impacting stormwater quality on the STM site, as discussed in Section 4.1. Analytical results for 1992 and 1993 stormwater monitoring are located in the following references: Applied Environmental/SEC Donohue, 1992, and Rust, 1994a.

With one exception, all parameters analyzed indicate that NREL's activities are not causing contamination of stormwater runoff. The value for total suspended solids was elevated at the sampling location immediately below the SERF construction site. This is probably a temporary condition because the sample included runoff from the construction site before successful revegetation had been completed.

6.2 Other Non-Radiological Data

No emissions monitoring has been conducted by NREL with the exception of the wastewater monitoring described in the previous section. All other monitoring has been surveillance type sampling.

6.2.1 Air Data

A PM-10 monitoring program for particulates in ambient air was begun in May 1992 and concluded in December 1993, as described in Section 4.1.

After 1.5 years of sampling (May 1992 through December 1993), no significant difference was found between the measurements at upwind and downwind samplers. This indicates no significant impact

on ambient air quality due to SERF construction activity. In addition, ambient air at the STM site was below the state's annual maximum limit of 50 micrograms per standard cubic meter with two exceptions and was always well below the 24-hour maximum limit of 150 micrograms per standard cubic meter.

Small quantities of toxic gases such as arsine or phosphine have been used in the past in the photovoltaic laboratories in Building 16. In mid-1991, an independent audit of the toxic gas operations was performed, resulting in a temporary suspension of toxic gas operations to allow time for re-evaluation of these activities. Substantial building modifications, including the installation of sprinklers, were made in early 1992 to allow these operations to resume. In 1993 and 1994, all pyrophoric and toxic gas activities were moved out of Building 16 and into the SERF on the STM site. There is currently 24-hour monitoring of these toxic gases to provide early detection of small releases in a controlled environment. This allows for corrective measures to be taken before a problem develops. Monitoring points also have been installed in the exhaust ventilation system to detect accidental or catastrophic releases to the environment. NREL has compiled a comprehensive document entitled An Emergency Response Procedure to the Toxic Gas Alarms (Solar Energy Research Institute, 1989). This document outlines the procedures, responsibilities, and emergency response requirements should an accidental toxic gas release to the environment occur. In addition, NREL's Emergency Preparedness Plan incorporates emergency notification requirements and procedures to mitigate the hazard to the environment and to the local community.

6.2.2 Waste Disposal

NREL has four separate RCRA waste generator identification numbers issued by CDPHE. One identification number was issued in 1980 for Building 16 in the DWOP and one was issued in 1988 for the STM site. NREL was assigned an identification number for the JSF in 1992 and for the NWTC in 1993. In 1994, NREL shipped a total of 3180 kg of hazardous waste from laboratories and facilities maintenance activities to an out-of-state EPA-permitted treatment, storage, and disposal facility. NREL disposed of 2287 kg of nonregulated waste (excluding sanitary waste) and no PCB-containing material or asbestos-containing material during 1994. NREL made no shipments of radioactive waste in 1994. The Laboratory collected the following materials for recycling: **107** kg of used oil, **222** kg of batteries, **76** kg of solvents, **39** kg of scrap copper, **340** kg of scrap stainless steel, **925** kg of scrap steel, 9,374 kg of newsprint, 28,910 kg of white, computer, and mixed papers, and 971 kg of aluminum cans. Quantities for waste and recycled materials are approximations only. The quantities provided above are the figures shown on manifests and other shipping documents, but the materials are normally not weighed when picked up by vendors. Typically, a vendor will provide his/her good faith estimate of quantity based on practical experience.

6.2.3 Soil Data

Reconnaissance soil sampling was conducted at the NWTC in 1993 and 1994 over the entire 280-acre site. Sampling was intended to characterize site soils and screen the soils for indications of potential contamination. No significant levels of contaminants were detected. The sampling data and a description of the methods and conclusions are contained in GTG-Fox, 1994.

6.3 Continuous Release Reporting

There were no releases of reportable quantities of regulated materials to the environment during 1994.

6.4 Environmental Occurrences

There were no significant releases of pollutants or hazardous substances during 1994. No reports were made to the Headquarters Emergency Operations Center or the Coast Guard National Response Center. There were two DOE reportable occurrences per DOE 5000.3B that had potential environmental implications; these were reported to DOE/GO. However, no release of a reportable quantity of hazardous material to the environment was involved in any of these three cases, so NREL was not required to notify any emergency response agencies.

In August of 1994, a four-ounce bottle of mercury was dropped in the lobby of Building 16 by a member of the research staff. Mercury was scattered over a wide area of the lobby floor. The building was evacuated, and NREL's emergency response team (ERT), in coordination with the Jefferson County Hazardous Materials Team, cleaned up the spill. There were no injuries or exposures as a result of the incident.



Figure 6.1 NREL Emergency Response Team member heads to the HAZMAT decontamination showers after completing a clean-up shift.

In November 1994, a 1-pound arsine gas cylinder was found to be leaking during a routine cylinder change-out procedure. The cylinder was immediately re-capped, preventing any further escape of gas. NREL's Toxic Gas Emergency Response Notification Procedure that is specifically designed for such an incident was implemented. Trained ERT personnel responded and performed monitoring. Additional leaking or residual arsine gas was not detected. The vendor was contacted and sent response personnel to NREL to return the cylinder to its (the vendor's) facility. Upon careful examination of the cylinder at its facility, the vendor was not able to detect any measurable loss in quantity of arsine gas, and considered the cylinder full. No injuries or exposures resulted from this incident.

6.5 Superfund Amendments and Reauthorization Act (SARA) Title III Reporting

In 1994, NREL had no chemicals in its inventory that exceeded the reportable threshold planning quantities, and no reporting to the Local Emergency Planning Committee or the local fire department was required. As there are no manufacturing operations at NREL, and most chemicals are used in small laboratory quantities, the Laboratory was not required to submit an inventory of routine chemical releases (emissions) to EPA under Section 313 (toxic release inventory) of SARA Title III for its activities during 1994.

7.0 GROUNDWATER PROTECTION

NREL has no RCRA hazardous waste units or RCRA/CERCLA remediation sites, so no groundwater monitoring for these purposes is conducted.

NREL conducts no groundwater monitoring at its leased facilities because the Laboratory has never had a release or discharge to the environment on the DWOP site. DWOP management contracted with an engineering firm to conduct a cursory groundwater monitoring study in 1988 adjacent to the NREL-leased buildings. Two monitoring wells were drilled, and groundwater samples were analyzed for VOCs, cyanide, 13 priority pollutant metals, acid and base/neutral extractables, PCBs, pesticides, and phenols. All metals were below 1 ppb and none of the remaining analytes were detected with the exception of trace amounts (<5 ppb) of trichlorofluoromethane and 1,1-dichloroethane, two common industrial solvents. NREL acquisition records indicate that, at the time of the study, the Laboratory had never purchased either chemical.

NREL commenced a groundwater monitoring program at its STM site in 1990 for the purpose of characterizing groundwater beneath the site and to confirm that NREL activities were not adversely impacting groundwater quality. Eight groundwater monitoring wells were drilled in August 1990 to depths ranging from 18.8 to 36.5 feet below ground surface (Applied Environmental Consulting, Inc., 1990). The wells are distributed over the majority of the developed portions of the STM site at the base of South Table Mountain to obtain samples that accurately represent groundwater quality throughout the site, particularly downgradient of NREL activities. Figure 7.1 illustrates the locations of the eight wells in relation to STM facilities. Three wells, MW-1, MW-2, and MW-3, are upgradient of all NREL activity and provide a good indicator of contaminants being transported onto the STM site. Six of the eight wells had dedicated sampling pumps. The remaining two wells had a water depth insufficient for dedicated pump operation and were sampled using a bailer or portable pump.

Initial groundwater sampling was performed from October to December 1990. Each of the eight wells was sampled quarterly for the first 5 quarters of monitoring. Because of the lack of contamination, the low permeability (0.006 to 0.015 feet/day) and the slow groundwater flow rates (between 0.18 and 1.8 feet/day), the decision was made following collection of 5 quarters of data to scale back the sampling. Sampling and analysis of groundwater have been performed on an annual basis since 1992, and annually thereafter with an expanded list of organic analytical parameters.

Two of the wells, MW-6 and MW-8, sustained damage in 1992 due to construction activity in the immediate vicinity of the wellbores. As discussed in Section 4.1, these wells and MW-7 (which was due to be impacted by upcoming construction) were permanently closed in 1993.

The analytical results of the sampling are summarized in Section 4.1 of this report. Data were compared with water quality criteria, primarily from the Colorado Basic Standards for Ground Water (5 CCR 1002-8) or from the National Primary Drinking Water Regulations (40 CFR Part 141), as a measure of the water quality at the STM site. Measured concentrations of the inorganic parameters tend to be either within the limits prescribed by the water quality criteria or in a range typical of

Figure 7.1 Groundwater Monitoring Well Locations at the STM Site

the Denver Aquifer. Table 7.1 compares STM groundwater data for 1994 with Denver Aquifer data contained in the most recent STM groundwater monitoring report from Rust Environment and Infrastructure, Inc. (1995b).

Table 7.1
Groundwater Aquifer Data

PARAMETER	DENVER AQUIFER	STM
Sodium	50 - 448 mg/l	46 - 93 mg/l
Nitrate	ND - 2.6 mg/l	0.2 - 1.2 mg/l
Chloride	4 - 114 mg/l	8 - 35 mg/l
Fluoride	0.3 - 2.4 mg/l	ND - 0.6 mg/l
Bicarbonate	170 - 370 mg/l	231 - 347 mg/l

To date, the results of 4 full years of monitoring have been reported. All wells have been sampled for all parameters, with the exception of two wells (MW-1 and MW-8) that had insufficient water to conduct tests for all analytes during some of the monitoring events. Monitoring results for 1994 are as follows.

None of the expanded list of volatile organics were detected during 1994. Neither herbicides nor pesticides have been regularly detected in any of the wells since monitoring was initiated.

Mercury was detected in four wells (MW-2, MW-3, MW-4, and MW-5) at a maximum concentration of 0.7 ug/l. Lead was detected for the first time in MW-4 at a concentration of 76 ug/l. The concentrations of mercury detected this quarter are significantly below the mercury limit (2 ug/l) as prescribed in the Basic Standards for Ground Water (5 CCR 1002-8).

Two semi-volatile organic compounds, 1-3-dichlorobenzene and bis (2-ethylhexyl) phthalate, were detected during 1994 monitoring at maximum concentrations of 5 ug/l and 6 ug/l, respectively. The phthalate is a plasticizer used in the manufacture of polyethylene tubing like that used for sampling and possibly in the analytical laboratory. The 1-3-dichlorobenzene was detected in all 5 samples and the blind QA sample. It is highly unlikely that a sudden increase would occur in all wells in a single quarter, therefore, the compound's presence is thought to be the result of analytical laboratory error.

With the single exception of lead, all parameters for which a Colorado ground water standard or drinking water Maximum Contaminant Level exists were within limits. No further routine groundwater monitoring is planned at the STM site, because baseline groundwater characterization is considered complete.

Table 7.2 summarizes the number of wells at NREL, their status, and their purpose.

Table 7.2
Groundwater Monitoring Well Summary

Site	Well No.	Status	Purpose
STM	MW-1	active	characterization and screening
STM	MW-2	active	characterization and screening
STM	MW-3	active	characterization and screening
STM	MW-4	active	characterization and screening
STM	MW-5	active	characterization and screening
STM	MW-6	abandoned, 1993	characterization and screening
STM	MW-7	abandoned, 1993	characterization and screening
STM	MW-8	abandoned, 1993	characterization and screening

8.0 QUALITY ASSURANCE

8.1 Quality Assurance Program

The quality and validity of all environmental monitoring programs depend on the implementation of strict quality assurance (QA) and data validation controls. An NREL Laboratory-wide QA manual for research, development, and demonstration work, as well as ES&H activities, has been completed (NREL 1993c) that incorporates the requirements of DOE 5700.6c. The NREL SSO-ES has also prepared an Environmental Engineering Section Quality Assurance Plan for all sampling and analyses under its control, including environmental monitoring activities (NREL 1993b). Where appropriate, NREL follows EPA-prescribed protocols for environmental sampling and analysis.

In preparation for each monitoring program, as well as nonroutine monitoring events, comprehensive quality assurance/quality control procedures (QA/QC) to be followed by field and laboratory personnel in collecting and analyzing samples are included in the monitoring work plans. In addition to QA measures incorporated in the monitoring procedures, periodic QA audits of subcontractor personnel performing environmental sampling are performed by the Environmental Engineering Section, in accordance with the Environmental Engineering Section QA Plan. For any additional environmental monitoring or surveillance work to be performed, QA procedures will be prepared specifically for each type of monitoring as part of the initial planning phase of the project.

8.2 Laboratory Certification

All laboratory analytical work resulting from environmental monitoring is sent to a subcontractor laboratory. It is the responsibility of the Environmental Engineering Section to select qualified subcontractor laboratories for the analysis of environmental monitoring samples. Barringer Labs, which has been monitoring groundwater quality for several years for DOE's Uranium Mill Tailing Remedial Action (UMTRA) program, was chosen for NREL's groundwater monitoring sample analysis from 1990 through 1993. Evergreen Analytical Inc. was used for the analysis of 1994 samples.

NREL used Accu-Labs Research, Inc., for ambient air monitoring and Evergreen Analytical Inc. for surface and wastewater sample analysis in 1993. An on-site inspection/QA verification was performed at both laboratories by the Environmental Engineering Section. A QA checklist was developed to be used as a guide for inspections of subcontractor laboratories. Laboratories chosen for future environmental monitoring sample analyses will be subject to equally careful scrutiny and verification measures with respect to their qualifications and QA procedures.

8.3 DOE Laboratory Quality Assurance Program for Radioactive Material

NREL conducts only two types of industrial hygiene monitoring for radiation as described in Section 4.1. No environmental radiation monitoring is conducted at NREL because of the very limited use of radioisotopes. NREL does not participate in the DOE interlaboratory QA program for radiological monitoring because laboratory analysis is not performed in-house.

8.4 Data Verification

Sampling and analytical data received from laboratories will undergo a data review process to ensure the validity and accuracy of the information before the results are used. Each data set received will be reviewed using the following procedure:

- * Verify that the proper sampling method and the recommended analytical procedures have been used.
- * Verify that the analytical results are reasonable given the known site conditions, sampling method, and analytical method.
- * Determine whether or not the results could have been affected by interferences.
- * Evaluate QA/QC data provided by the lab (e.g., results of blanks, duplicates, and spikes).
- * Review the potential sources of error and confirm that these errors have not occurred.
- * Compare data to previously obtained analytical results when previous data are available.

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